Message of John W. Hoyt, Governor of Wyoming to the Seventh Legislative Assembly, January 12, 1882 (Cheyenne: Leader Steam Book and Job Print, 1882)

REPORT OF TERRITORIAL GEOLOGIST FOR WYOMING.

OFFICE OF TERRITORIAL GEOLOGIST
AND MINING ENGINEER,
Cheyenne, Wyo., Jan. 11, 1882.

To His Excellency, John W. Hoyt, Governor of Wyoming:

DEAR SIR:—I have the honor to submit, very respectfully, my report herewith in accordance with the requirement of the statutes of Wyoming, and I have the honor to remain,

Your obedient servant,

FRED. J. STANTON,
Territorial Geologist and
Mining Engineer for Wyoming.

REPORT OF THE TERRITORIAL GEOLOGIST AND MINING ENGINEER FOR WYOMING.

My appointment to the office of territorial geologist and mining engineer for Wyoming was dated March 7th, 1881, and in accordance with the statute creating the office, I proceeded immediately to recommend the proper course for miners to pursue in the development of the mineral wealth of the country. Upon consultation with many of the leading citizens of the territory, I found that their idea coincided with my own, and that the practical development of their mines and their mining resources was the paramount idea contemplated in the creation of the office.

It being usual for the parental government at Washington to make the geological surveys of her wards, it remained for me to assist by every means in my power, with the meager salary accorded to me, the honest miner, to ascertain if his mine was a paying one or not, and whether there was any prospect of its ever becoming so. I have been the means of persuading many parties from pursuing an *ignis fatuus*, and I have also been the humble instrument in directing exertions in a proper and legitimate avenue.

That since my arrival in your midst there has been a decided impetus given to mining interests and enterprise and a desire to develop the mines and find the mineral which everyone believes exists in these grand old hills—no one will dispute. There is a more healthy, sound, practical idea about mining pervading the whole territory, which augurs well for the future.

Having, for over twenty years made the ores of copper my especial study, at an early period after my arrival, I found that the mining of copper was destined to be the great specialty of Wyoming in the near future. I bent all my energies to that one object, and everywhere I find an increased impetus to that industry; and the development of the mining camps of Copperopolis and Hartville, near Fort Laramie, with the "Green Mountain Boy" mine, which is the only legitimate paying mine in the territory, has proven my view was a correct one. That this is the only paying mine in the territory is owing probably to the utter absence of any one whose especial duty was to look after her mining interests. As I am writing this, comes the news of another discovery at Muskrat Canyon, 25 miles from Copperopolis, in the same great copper belt which stretches from Lake Superior to the California seaboard on one flank, and the Mexican seaboard on the other.

Ere long, through the whole course of that immense

range comprised in the area of Wyoming, will continuously come new discoveries, until she will occupy the frontal position in the great copper producing sections of the world. This is not hypothetical, but a certain definite proposition as plain as two *plus* two equals four. Wyoming has within her boundaries the finest species and varieties of copper ore yet found in the known world.

To expatiate upon the immense industrial products of the territory would only be a work of supererogation, as the field has been so ably covered by the report of the governor.

Wyoming needs only well directed perseverance and energy in the field covered by the office of territorial geologist and mining engineer; and if in your judgment, a continuance of my exertions in that field will redound to the best interests of the territory, I shall be most happy to continue them.

I have not been able to visit as many localities as I would have wished, but that is owing to the reason that each locality must be taken *seriatim* and worked up as time and circumstances will permit.

It would be invidious, where localities are so equally rich as in Wyoming, for me to mention them individually. The amount of work I devoted to Colorado during so many years, is an earnest of what I intend to do for Wyoming. Suffice it to say, that my whole energies shall be devoted to the building up of her mineral resources and making her ere the annual cyle of time may roll over many times, the peer of Colorado.

GEOLOGICAL DATA.

The summit of the grand nucleal area of the Rocky Mountain series of the archæan formations, once upon a time, was probably 10,000 feet or nearly two miles

higher than it is now, estimating from our present standpoint of observation. When the upheaval came, the east base of the mountains was far below the level which we now occupy. Then all these mountain peaks, ranges and spurs formed one grand, massive continental plateau or divide; the *divertia aquarum*, or water shed of the American continent, and their investigation forms a beautiful study in structural geology, learning how, by the agency of atmospheric and aqueous erosion, they were fashioned and cut up into their present varied and fantastic forms. For illustration, let us take the Chugwater, a little, puny, insignificant stream; formerly it was a gigantic river, two miles wide, and its torrents rolled and roared like a mighty ocean. This insignificant little water course, which is the remnant of that ancient river, where the mastodon, the mammoth and the dinotherium monsters wallowed like the walrus on its swampy shore, and the gigantic bat-like pterodactyl, the ichthiosaur, iguanodon and megalasaur peopled its waters; when Prof. Marsh's Atlantisaurus, his elaps, titanasaurus and camptosaurus in the Wyoming jurassic period; and one of the missing links of Darwin, the great toothed bird, or "bird of the evening," six feet long, swam this immense river, fought the land animals on its borders and fed upon the fish which peopled its waters, seems now almost a sarcasm on the "what has been." On the western side the escarpment is a gradual inclination formed by the filling in of the debris of the centuries, washed from the mountains. The mind can perhaps grasp the idea of the immense height of the mountains by the great depth of the tertiary washings from their summits, which, in boring for artesian water, has been proved to extend 1,500 feet, and no bottom of the period reached, and no indication of the secondary and stratified rocks.

MINERAL BELTS.

We have immense mineral belts all through Wyoming from north to south, continuations of the Black Hills formations, and still continuing, of the same characteristics, down along the western edge of the North Park to Georgetown, in Colorado, comprising ferruginous quartz veins, near the surface, carrying free gold, from 2½ to 4 feet wide, with injections below of iron pyrites, carrying varying amounts of silver. Near the surface are found innumerable gash or segregated veins of the green carbonates of copper, as leaders to the gold and silver sulphuret veins below. These veins generally have a strike, with a slight variation from east to west. They are also crossed or intersected by copper veins (sulphurets), such as copper pyrites and peacock copper ore, with surface deposits or pockets of the carbonates capping over or covering the veins, which run north and south with slight variations.

GREAT COPPER BELT.

That there is an important copper belt in the Laramie range or Black Hills of Wyoming there can be no dispute. It extends from Graite Canyon station, on the U. P. Railroad, by the old Metcalf smelter, and the Table Mountain, comprising the Silver Crown mining district, along the range northerly to the Laramie Peak, where it makes a deflection to the northeast, crosses the North Platte river, continues along by Copperopolis, Hartville, the old Government Farm, up to Muskrat Canyon, Rawhide Buttes, the Niobrara or Running Water, and thence on to the Black Hills of Dakota. This belt varies in width from eight to twelve miles; it has spurs and parallel belts, evidences of which have been well defined at Cummins, Laramie, Rawlins, Carbon and especially Brown's Park, on Green river. The same formations exist

down Bear river, and in the neighborhood of these fossil beds rich deposits of copper will yet be found.

There is copper all over Wyoming from Cheyenne to the Yellowstone and the National Park, where the immense geysers are pouring their rich sublimations from the inner crust of the earth to the surface—that wonderland of America. From Evanston to the Black Hills, near Deadwood—east, west, north and south—copper is everywhere.

THE ECONOMY OF COPPER.

That copper will be the present economical industry of Wyoming mining there can be no doubt. Everywhere the evidences are looming up that we shall soon become essentially a copper producing territory. These copper ores vary from ten to sixty per cent., the amount of which is so vast that the human mind cannot grasp it, within the boundary of Wyoming.

In Lake Superior five per cent. copper ore is worked to advantage, and the mines there are making princely monthly dividends.

At Swansea, Wales, two and a half and three per cent. copper ores (pyritous, and called refractory) are received by schooners from thousands of miles distance and worked to immense advantage, making princely fortunes to the European mine owners and smelters. Is Yankee ingenuity and skill getting so aristocratic as to touch nothing but 40, 50, 60 and 70 per cent. copper ores?

Copper pays from the grass roots. A copper camp is a poor man's camp. This carbonate of copper lies on the surface; you can see its value on the face of it. The active carbonization of copper is going on every day around and about us. The lime formations are chemically changing in every mining camp in Wyoming, the sulphurets to the carbonates, assisted probably by the

decomposition of vegetable matter, together with the carbon dioxide in atmospheric air.

FORMATION OF CARBONATES.

Carbon is the base of carbonic acid and is the most considerable element of the solid parts of animals and vegetables; it forms one-eigth part of marble and many of the commonest rocks we find all around us in nature. That the metals once existed in their pure and uncombined state originally, I have no doubt; also, that the sulphurets were formed by the decomposition of the base, by means of sulphur and iron forming sulphurous and sulphuric acid.

Again, that these same sulphurets were subsequently reacted upon by carbonic acid as found in vegetation, and the organic portions of shells and many rocks, and formed into carbonates; just in the same way as the carbonate of lead, or white lead, is made by the manufacturer. Do we not see the carbonic acid gas bubbling up from the bottom of our mineral springs? Where does this great agent, carbon, come from? What figure does it cut in nature, if it does not assist in producing the carbonates? We know sulphur and iron form the sulphurets, and hydrochloric acid gas generated by the decomposition of common salt, or chloride of sodium, forms common soda and the metallic chlorides, and the generation of bromine gas from the decomposition of sea weeds and other peculiar vegetation forms the bromides.

It used to be heterodox to say that the carbonates are simply decompositions of the sulphurets; but in the light of experience in Colorado, and particularly the vast carbonate fields of Wyoming, it is disclosed to the scientist that the carbon dioxide or carbonic acid, as generated by the decomposition of vegetable matter of the luxuriant flora of the carboniferous period, and also that the

carbonate of lime formation, has decomposed the sulphurets left by the upheaval and rending of the earth's crust; in common with the upper portion and all around the surface of veins, and changed them into carbonates. This, no doubt, has been done by infiltration and chemical solution, and may give color to the theory of the filling of veins by aqueous agency.

The formation of the carbonates may have arisen from other causes than what is apparent now at the surface of our earth. It must be remembered that the ancient seas from which the fossil shells all over the Rocky Mountains were thrown up, were very different in their composition than those of our modern seas. Carbonic acid formed a much larger part of them than those of to-day. The removal of that carbonic acid, and the rapid decomposition of the igneous rocks and the limestones, can easily account for the formation of such vast areas of the carbonates of copper, iron and lead, all over the Rocky Mountains. The growing plants of that period, when these mountains were hurled over by the titanic power of an almighty fiat, drew life from the atmosphere of almost pure carbonic acid gas, which then enveloped our globe, and long before man breathed the breath of life, which is full of oxygen and the very antipodes of carbonic acid.

The carbonates are continually forming, and I have noticed it myself very often, besides having my attention drawn to it by others. On a late visit to the Table Mountain mines, Dec. 14, 1881, I found several beautiful colored specimens of the malachite, azurite and chrysocalla ores of copper, which had formed in the crevices of veins since my former visit in October last.

This same peculiarity of the continuous formation of the carbonates and silicates has been noticed by many others, as well in this as in other localities. Mr. Wright, an eminent authority, says he opened a vein that had not

been worked for years, and from which the ore had been well cleared out, and he found that the sides of the vein had been replenished with the carbonate of lead, in crystals of an inch in length, which, no practical man can doubt, had been formed since the period when the mine was worked.

Electricity may probably form an active agency in the continuous formation of these metalic deposits, but I am more inclined to believe, from many years of earnest study of these idiosyncracies of nature, that they are formed by gaseous saturation and infiltration.

DEPOSITS OVER VEINS.

The miners in Colorado, generally, have fallen into a very erroneous idea about carbonate deposits. They generally believe that no fissure veins exist in connection with the carbonates. I contend that beneath these deposits, as a rule, will be found fissure veins, and that these deposits are what in vulgar parlance might be termed "slop overs" from a vein.

The carbonate deposits are always in connection with veins, and it matters not, in my opinion, whether a deposit or bed of carbonate material is worked out or not, the fissure vein will still be left below, not in the lime or contact, between porphyry and lime, but in the older metamorphic transition or igneous rocks below, to be found by careful and scientific exploration. The fact of a carbonate deposit being worked out, is but the beginning of the work. The sulphurets in the veins below extend regularly in true crevice style, how far, the God of nature only knows.

In the vicinity of fissure veins are often found collections of segregated or gash veins, which are really irregular streamlets, as it were, of ore, oftentimes very rich in mineral, but are not permanent and continuous to a great depth, and only lead to the true fissure vein, which they do pretty generally.

REDUCTION OF COPPER.

The reduction of copper is not properly understood, and much improvement can be made in the different processes. The carbonates can be reduced, and the pure metal extracted, cheaper than any ores known, except chlorides; much cheaper than iron. Copper will pay to work and reduce even if the market price of it was to go down nearly to the price of iron.

The necessity of a smelter in every camp is paramount. Great care should be exercised in the selection of the proper process. A proper smelter can be found, but it requires careful investigation and caution for its adaptation to the kind of ore treated. These ores are peculiar, and the process must be exactly fitted to them or disaster and failure will result. In Colorado nine tenths of the terrible failures, during the last twenty years, which has cost her without exaggeration as much as the gross amount of her production, has been caused by the mismanagement of her mines and her smelters.

There are many processes for the reduction of copper sulphides. The process is by treating the ore in a reverberatory furnace to a dead roast for three or four hours, then pour into a bath of salt solution. This forms a chloride of copper and silver (if any). The silver and copper can be precipitated in the usual manner. The cost of this process is about $17.50 per ton.

Another process is to roast the sulphides in heaps, about five weeks, in the open air. Give it a chloridizing roast in a reverberatory furnace, by the addition of salt; then use a galvanic battery to precipitate metallic copper and silver.

The copper carbonates can be reduced by a proper fluxing of them with other ores.

The best process is the use of a cupola furnace, with a water jacket, which has been tested so often, and proven so conclusively, in the copper mines of California, Colorado, Arizona and New Mexico. A ten ton furnace of this style can be put up in any mining camp for about $5,000. There is no brickwork—it is all iron. If the ore gives out it can be removed to another camp without injury.

Another process, by using sulphuric acid, forming a sulphate of copper (blue vitriol), by evaporation, a marketable product, or the precipitation by iron, forming a sulphate of iron (copperas), also a marketable product.

Copper sulphides, like pyrites, can be concentrated by a very simple process, with firewood.

NO REFRACTORY ORES.

There are no such things as refractory ores, but there are such institutions as unscientific and unskillful ore reducers and manipulators; they, by their want of knowledge of the mode of oxidation of the metals, make ores what they term refractory. If we want to manipulate some minerals with the oxyhydrogen blowpipe, the manipulator must know what flame of the blowpipe to use, the oxidizing or reducing flame, to achieve the result he aims at. It requires less heat to drive off sulphur than arsenic, and less for arsenic than antimony. Every smelter of ores should, and indeed must to be successful, understand the chemistry of metals, as well as their nomenclature.

MANUFACTURE OF SULPHURIC ACID.

I cannot conclude my report without strongly recommending to our people the establishment of sulphuric acid works. The sulphur of pyrites can be found in vast quantities, very cheaply, and sulphuric acid manufactured for $1.75 per hundred pounds. By the carboy, at Denver, it cannot be bought less than from $5 to $6. The plant will cost about $5,000. Nitro glycerine can then be manufactured, with dynamite and giant powder, which will save to the miners a large amount.

NEBRASKA STATE FAIR.

In September last a number of our prominent citizens wished me to make a collection of the mineral resources of Wyoming, and exhibit them at the state fair of Nebraska. I did so, and succeeded in obtaining the premium for the best display of minerals. By permission of L. Burnham, Esq., the land commissioner of the Union Pacific railroad, I exhibited our minerals in the railroad department, and I feel satisfied that at least 25,000 people examined them, and listened to our description of the localities from which they came, during the week of the fair.

ILLINOIS STATE FAIR.

I also attended the Illinois state fair, and passed through the same experience at Peoria, where the copper and other products of Wyoming received the very highest enconiums, but on account of the rules I was unable to enter them for competition.

I went with the specimens also to Milwaukee and other places, and exhibited them at the Palmer house, Chicago. Everywhere that I visited the press spoke very highly of the exhibition of the resources of Wyoming.

At Omaha and Chicago I visited various smelting and reduction works, to add to my experience in the metallurgical treatment of Wyoming ores.

I feel that my trip was of considerable value to the territory, and the kind expressions of satisfaction received from almost every quarter, abundantly satisfied

me for having thus, at my own expense, advertised to the best of my ability, the wonderful resources of Wyoming, and I know that it has caused a more favorable consideration in our behalf, and the enlistment of considerable capital to develop our mines.

BUILDING STONES TO WASHINGTON.

By a private letter from Washington I ascertained that every state and territory in the United States, with the exception of Wyoming, had sent collections of their building stones to the Smithsonian Institute, a description of which was to swell an extensive work on that subject, being prepared by order of congress. I immediately did all I could to make a creditable collection of the building stones of Wyoming, and will forward them to Washington at as early a day as possible.

In conclusion, I beg most respectfully to further represent, that the immense mineral wealth which lies undeveloped in the great valleys of the Sweetwater and Wind river, and the northern country subsidiary to them, demands the most earnest and devoted attention, and that will be one of the duties of my future work. No one can estimate the value of that fruitful mineral region. Large amounts of money have been spent, but it has been unscientifically directed, therefore a failure. The people of the territory can reasonably expect, I feel satisfied, a grand future for that interesting section, in common with almost every other portion of our territory, for it is saturate with mineral wealth, and requires only well directed energy and perseverance to develop.

And I have the honor to remain,

Your obedient servant,

FRED. J. STANTON,

Territorial Geologist and Mining Engineer for Wyoming.